

Hydrologic Engineering Center

Training Course on

**HYDROLOGIC ENGINEERING FOR PLANNING**

Davis, California

Objectives

This course provides an understanding of basic hydrology and hydraulics concepts and their application in water resource planning. It is designed to give participants a conceptual understanding of hydrograph analysis, fluvial hydraulics, frequency analysis, reservoir studies, and management of hydrologic studies. This course is intended for professionals engaged in planning who have a limited background in the basic principles and theory of hydrology and hydraulics and their applications in planning studies.

## Monday

8:00	- 9:00 a.m.	Introductions
9:00	- 9:15 a.m.	Break
9:15	- 10:15 a.m.	Lecture 1.1 <b>Introduction to Hydrologic Analysis</b>  The role of hydrologic analysis in planning will be presented. The objectives and basic concepts involved in hydrologic evaluations and the contrast between hydrologic process and evaluation needs will be discussed (Refer to Training Document No. 14, Chapter 11)
10:15	- 11:00 a.m.	Lecture 1.2 <b>Hydrology and Hydraulics in Flood Damage Reduction Studies</b>  A flood damage reduction study is defined. The hydrologic, hydraulic and damage components of a flood damage reduction study are identified.
11:00	- 12:00 noon	Lecture 1.3 <b>Introduction to Hydrograph Analysis</b>  Description of hydrologic system components and their relative importance in analysis, basin precipitation and loss determinations. (Chapters 2-4)
12:00	- 1:00 p.m.	Lunch
1:00	- 2:00 p.m.	Lecture 1.4 <b>Unit Hydrograph Analysis</b>  Describe the theory, assumptions and derivation of a unit hydrograph by the isolated Storm Method. Demonstrate the application of the unit hydrograph. (Chapter 5)
2:15	- 3:13 p.m.	Lecture 1.5 <b>Basin Modeling</b>  Describe the general concepts and selected techniques that are relevant to basin modeling. General concepts of regionalization will also be presented. The effects of land use on the hydrology of urban watersheds will be described. (Chapters 6-7)
3:15	- 3:30 p.m.	Break
3:30	- 4:30 p.m.	Workshop 1.6 <b>Concepts Associated with Rainfall-Runoff</b>  Familiarization with the hydrograph and units, and conceptual application of the unit hydrograph in an urban setting will be stressed.
4:30	- 5:00 p.m.	Workshop Review

## Reading Assignment

Training Document #14: Review Chapters 1 through 7. Read Chapters 8 through 15.

## Tuesday

8:00	- 9:00 a.m.	Lecture 2.1	<b>Introduction to Flood Routing</b>
			The definition and purpose of flood routing is presented. Effects of natural valley and reservoir storage on streamflow and the purpose of flood routing are summarized. Hydrologic and hydraulic routing methods are introduced, along with discussions on when to apply a particular method. (Chapters 8 and 14).
9:00	- 9:15 a.m.	Break	
9:15	- 10:15 a.m.	Lecture 2.2	<b>Basic Principles of Streamflow Profiles</b>
			Procedures for relating flow to stage will be discussed. Basic concepts of open channel hydraulics, including energy losses and gradually varied flow profiles will be presented. (Chapters 10 and 11)
10:15	- 11:00 a.m.	Lecture 2.3	<b>Demo: Introduction to HEC-RAS</b>
			Basic data input and use of HEC-RAS for water surface computations using HEC-RAS will be demonstrated.
11:00	- 12:00 noon	Lecture 2.4	<b>Sediment Transport in Natural Streams</b>
			The natural formation of stream channels flowing through alluvial material will be presented. Concepts of sediment transport and the effect of physical works will be discussed. (Chapter 15)
12:00	- 1:00 p.m.	Lunch	
1:00	- 1:45 p.m.	Lecture 2.5	<b>Stage-Discharge Uncertainty</b>
			This lecture will focus on quantifying the uncertainty in stage discharge relationships. Discussions include: uncertainty in measured stage – discharge relationships and computer water surface profiles; sensitivity analysis and professional judgment; as well as uncertainty for with-project conditions.
1:45	- 2:45 p.m.	Lecture 2.6	<b>Data Requirements for Hydraulic Analysis</b>
			Data requirements and considerations for computations will be presented. The relative effect of various factors of flow, geometry, roughness and local obstructions will also be illustrated and discussed. (Chapters 12 and 13).
2:45	- 3:00 p.m.	Break	
3:00	- 5:00 p.m.	Workshop 2.7	<b>Hydraulics Laboratory (</b>
			A field trip to UCD Hydraulics Laboratory.

## Reading Assignment

Training Document #14: Read up on “Frequency Analysis” (Chapters 16 through 23)

### Wednesday

- 8:00 - 8:45 a.m.      Hydraulics Review
- 8:45 - 9:45 a.m.      Lecture 3.1      **Concepts and Principles of Flow Frequency**
- An introduction to the probability concepts of hydrologic phenomena, the distinctions between risk and uncertainty, and a general approach to flow frequency analysis and risk assessment will be given. The frequency curve will be defined. (Chapters 16 and 17)
- 9:45 - 10:00 a.m.      Break
- 10:00 - 11:00 p.m.      Lecture 3.2      **Determination of Flow Frequency Curves**
- Graphical and analytical techniques and their respective applications will be presented. The reliability of derived frequency curves and the principles of regional analysis will be discussed. (Chapters 18-21)
- 11:00 - 12:00 noon      Lecture 3.3      **Conditional Non-exceedance and Regional Frequency Curve Analysis**
- Introduction to the concept of reliability and the use of regional analysis in evaluating flow frequency curves.
- 12:00 - 1:00 p.m.      Lunch
- 1:00 - 2:30 p.m.      Lecture 3.4      **Risk Analysis for Flood Damage Reduction**
- Overview of risk-based analysis policy for flood damage reduction studies will be presented. Definition of risk and uncertainty will be provided with a presentation of the risk-based analysis process using Monte-Carlo simulation. Discussion and interpretation of the results.
- 2:30 - 2:45 p.m.      Break
- 2:45 - 4:15 p.m.      Workshop 3.5      **Interpretation of Frequency Curves**
- A variety of frequency curves will be analyzed and apparent differences discussed with the objective of understanding the value of frequency curves.
- 4:15 - 5:00 p.m.      Workshop Review

### Reading Assignment

Training Document #14: "Introduction to Reservoir Yield Studies (Chapter 25)

## Thursday

8:00	- 9:15 a.m.	Lecture 4.1	<b>Concepts in Sizing Reservoirs and Operation</b>
			The need for and use of reservoir storage for flood control, water supply, hydropower and other purposes will be presented and discussed. Concepts in sizing, operation, and reallocation of water supply and flood control reservoirs, and the complementary and competitive aspects of multipurpose projects will be described. (Chapter 25)
9:15	- 9:30 a.m.	Break	
9:30	- 10:30 p.m.	Lecture 4.2	<b>Groundwater and Conjunctive Use</b>
			This lecture will explore the role of groundwater in the hydrologic cycle. Groundwater flow and storage concepts will be presented along with methods for setting the water-exchange between groundwater and surface water. Finally, the efficient management of groundwater and surface water resources in a watershed will be discussed.
10:30	- 12:00 noon	Lecture 4.3	<b>Analytical Perspective on Flood Damage Mitigation</b>
			The effect of changing the land use, adding reservoirs, levees, and channel modifications on frequency curve will be discussed.
12:00	- 1:00 p.m.	Lunch	
1:00	- 1:30 p.m.	Lecture 4.4	<b>Overview of Corps' Environmental Operating Principles</b>
			Overview of Corps' Environmental operation principles and the interaction of the hydrologic and biological sciences in the conduct of environmental studies.
1:30	- 3:00 p.m.	Lecture 4.5	<b>Ecosystem Restoration Tools: The Ecosystem Functions Model</b>
			An overview of how surface and groundwater models are used to further ecosystem restoration objectives in the Corps of Engineers. The type and nature of hydrologic engineering data, analyses, and results needed for riverine studies will be described. The Corps new Ecosystems Function Model (EFM) will be described.
3:00	- 3:15 p.m.	Break	
3:15	- 4:45 p.m.	Workshop 4.6	<b>Fisheries Modeling</b>
			Information and analysis methods applied for the Cache la Poudre River aquatic ecosystem analysis project will be presented. Project objectives will be presented and the biological and hydrologic engineering requirements that constrain viable alternatives will be discussed. Students will be given the opportunity to analyze and interpret data in an effort to enhance the sport fishery on the River.

Friday

8:00	- 9:15 a.m.	Lecture 5.1	<b>Innovative Tools: Flood Warning Systems</b>
			This lecture will describe flood warning system components. It will describe the hydrologic engineering analyses required to plan, design, and implement a system, and it will illustrate how the hydrologic engineering technology is integrated.
9:15	- 9:30 a.m.	Break	
9:30	- 11:00 a.m.	Lecture 5.2	<b>Case Study: Methods in Flood Hydrology: Synthetic Rain Floods for the California Central Valley</b>
			Case study details methods developed and used during the preparation of flood hydrology for the Sacramento and San Joaquin River Basins Comprehensive Study, which is a General Investigation project exploring opportunities to improve flood damage reduction and ecosystem health in the Central Valley, California.
11:00	- 12:00 noon	Course Summary and Critique	